

# **Technical Information Sheet**

## **Chondroitin Sulfate Oligosaccharides**

**MARUKYOU BIO FOODS Co., Ltd.**

# 1, Basic Information

<b>Product No.</b>	<b>MBF834001</b>
<b>Product name</b>	Chondroitin sulfate oligosaccharides
<b>Quantity</b>	10 g per vial
<b>Molecular weight</b>	Average less than 2kDa
<b>Purity</b>	More than 90%
<b>General Description</b>	<p>This chondroitin sulfate oligosaccharide is produced by subcritical hydrolysis of high-molecular-weight chondroitin sulfate extracted from skate cartilage, followed by ultrafiltration and activated carbon purification.</p> <p>Subcritical hydrolysis randomly cleaves <math>\beta</math>-glycosidic bonds, resulting in the inclusion of even-numbered sugars where the non-reducing end is either GlcA or GalNAc(S), along with two types of odd-numbered sugars. Because it is produced by hydrolysis, the non-reducing end of the oligosaccharides does not contain a double bond.<sup>1)</sup></p>
<b>General formula</b>	$(\text{GlcA} - \text{GalNAc,6S or 4S})_n$ (min 60%) and $(\text{GalNAc,6S or 4S} - \text{GlcA})_m$
<b>Appearance</b>	White powder
<b>Origin</b>	Skate Chondroitin Sulfate
<b>Toxicity and Hazards</b>	<p>We are not aware of any toxicity associated with this product. Please read the SDS carefully and In common with good laboratory practice the material should only be handled by qualified personnel trained in laboratory procedures and familiar with potential hazards.</p> <p>This product is not intended for human consumption, drug use or any form of human experimentation.</p>
<b>Applications</b>	Biological/biochemical laboratory research
<b>Storage</b>	We recommend that all products are stored below 4°C at dark and dry upon receipt and that they are allowed to warm to room temperature before opening.
<b>Solubility</b>	Soluble in water. Practically insoluble in alcohol.

## 2, Regarding Structural Isomers of Chondroitin Sulfate Oligosaccharides

Number of sugars	sulfate group	Bipolar structure	Structural formula	Unit Structure	Sulfated structure
Even-numbered	0S/4S/6S/ UA2S,6S	UG	GlcA-GalNAc		0S: $R_{1\sim3} = \text{OH}$ 4S: $R_2 = \text{OSO}_3\text{Na}$ , $R_{1,3} = \text{OH}$ 6S: $R_3 = \text{OSO}_3\text{Na}$ , $R_{1,2} = \text{OH}$ UA2S,6S: $R_{1,3} = \text{OSO}_3\text{Na}$ , $R_2 = \text{OH}$
		GU	GalNAc-GlcA		0S: $R_{1\sim3} = \text{OH}$ 4S: $R_1 = \text{OSO}_3\text{Na}$ , $R_{2,3} = \text{OH}$ 6S: $R_2 = \text{OSO}_3\text{Na}$ , $R_{1,3} = \text{OH}$ UA2S,6S: $R_{2,3} = \text{OSO}_3\text{Na}$ , $R_1 = \text{OH}$
Odd-numbered		UU	GlcA-GalNAc-GlcA		0S: $R_{1\sim4} = \text{OH}$ 4S: $R_2 = \text{OSO}_3\text{Na}$ , $R_{1,3,4} = \text{OH}$ 6S: $R_3 = \text{OSO}_3\text{Na}$ , $R_{1,2,4} = \text{OH}$ UA2S,6S: $R_{1\text{or}4,3} = \text{OSO}_3\text{Na}$ , $R_2 = \text{OH}$
		GG	GalNAc-GlcA-GalNAc		0S: $R_{1\sim5} = \text{OH}$ 4S: $R_{1,4} = \text{OSO}_3\text{Na}$ , $R_{2,3,5} = \text{OH}$ 6S: $R_{2,5} = \text{OSO}_3\text{Na}$ , $R_{1,3,4} = \text{OH}$ UA2S,6S: $R_{2\text{or}5,3} = \text{OSO}_3\text{Na}$ , $R_{1,4} = \text{OH}$
Single	4S/6S	G	GalNAc(4S/6S)		4S: $R_1 = \text{OSO}_3\text{Na}$ , $R_2 = \text{OH}$ 6S: $R_2 = \text{OSO}_3\text{Na}$ , $R_1 = \text{OH}$

### 3, Physical and chemical properties

1. Solubility: Easily soluble in water. Practically insoluble in organic solvents.
2. Structures with a glucuronic acid reducing end exhibit extremely low reactivity via reductive amination.  
Examples include 2merGU, 3merUU, 4merGU, 5merUU, etc.
3. Structures with an N-acetylgalactosamine reducing end readily undergo peeling reactions with alkali, resulting in low-molecular-weight products.  
For example, 3merGG decomposes into 2merGU and  $\Delta$ GalNAc(S).

Conversely, structures with a glucuronic acid reducing end are less prone to peeling reactions with alkali.

# Analysis Example

May vary slightly by lot. Analysis sheets are included with the product.

## SPECIFICATION SHEET

Product name	Chondroitin Sulfate Oligosaccharide(Mix)
Product CODE	MBF834001
substance name	Chondroitin Sulfate Oligosaccharides
Lot No.	20250804
Countries of Origin of Fish Raw Material	JAPAN
Scientific name of Fish Raw Material	Raja pulchra
Portion of using	cartilage

item	Result	method
Appearance	White to beige powder	Visual
Chondroitin Sulfate Assay	97.6 %	HPLC
Weight-average molecular weight	1942	HPLC

Disaccharide composition (wt%)	
Di 6S	78
Di 4S	17
Di di4,6S	0
Di di6S-UA2S	4
Di 0S	1

Glycan composition (wt%)	
GalNAc(S)	0.7
2mer(OS)	1.5
2mer	4.0
3mer	8.9
4mer	10.4
5mer	11.4
6mer	10.8
7mer	9.5
8mer	8.8
9mer	5.9
10mer	7.2
12mer ↑	20.9

Remarks : No double bond at non-reducing end



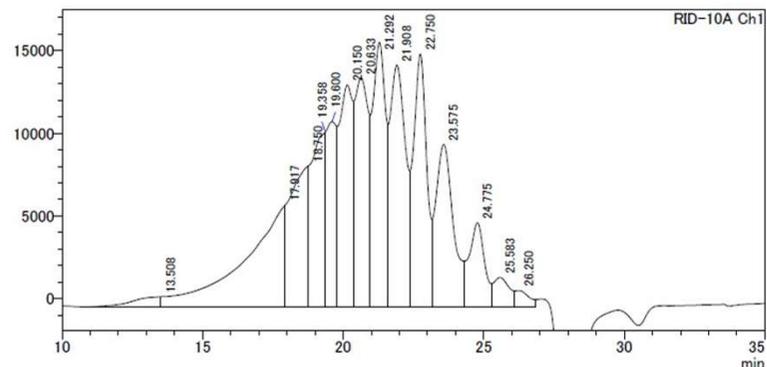
Fine Chemical Lab., MARUKYOU BIO FOODS Co., Ltd.  
2-1-40 Nishimiyanosawa 4-Jo Teine-ku Sapporo Hokkaido , JAPAN

## 【Product Data Sheet HPLC】

Product name	コンドロイチン硫酸オリゴ糖, Mix
Lot No.	20250804

HPLC: SHIMADZU Prominence LC-10  
Column: Superdex 75 Increase 10/300 GL  
Buffer: 50mM NH<sub>4</sub>HCO<sub>3</sub>  
Flow Rate: 0.7 mL/min  
Detection: RI

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<ピークレポート>

ピーク#	保持時間	ピーク開始	ピーク終了	面積	高さ
1	13.508	11.033	13.508	40907	604
2	17.917	13.508	17.917	603443	6112
3	18.750	17.917	18.750	370253	8509
4	19.358	18.750	19.358	350444	10540
5	19.600	19.358	19.792	285497	11200
6	20.150	19.792	20.367	427949	13417
7	20.633	20.367	20.958	459399	13847
8	21.292	20.958	21.600	521551	15997
9	21.908	21.600	22.367	551527	14613
10	22.750	22.367	23.158	505189	15289
11	23.575	23.158	24.308	430043	9821
12	24.775	24.308	25.275	193763	5085
13	25.583	25.275	26.100	70858	1772
14	26.250	26.100	26.833	33100	981
合計				4843924	127788



## 4, Owned Research on Chondroitin Sulfate Oligosaccharides

- 1, Regarding oral absorption, we have conducted studies using inverted intestines, Caco-2 cells, rat administration tests, and human administration tests.<sup>3)</sup>
- 2, We are researching methods for the separation and purification of chondroitin sulfate oligosaccharides with a single molecular weight.<sup>4)</sup>
- 3, We conducted human administration trials to evaluate the efficacy of improving joint pain.<sup>5)</sup>
- 4, We conducted administration studies in rats and humans to evaluate the antihypertensive effects, performed in vitro cell culture experiments with various cell types, and are conducting molecular biological investigations into the mechanism of action. (Paper in preparation)
- 5, We are conducting in vitro culture experiments with various cell types to investigate the effects of Nrf2 activation in upregulating antioxidant response genes to protect cells from various stresses, and are performing molecular biological analyses to elucidate the underlying mechanisms. (Paper in preparation)
- 6, We are conducting in vitro culture tests with melanoma cells to evaluate the melanin production-suppressing effect and are performing molecular biological investigations into its mechanism of action. (Paper in preparation)
- 7, In human administration trials, we elucidated its effects of suppressing plasma creatine kinase activity and inhibiting hypertension.<sup>6)</sup>
- 8, We are researching the effect of chondroitin sulfate oligosaccharides in suppressing melanin production. (Paper in preparation)

## 5, Reference

- 1) Yamada, S., Mass preparation of 29 oligosaccharides by the hydrolysis of chondroitin sulfate polysaccharides with a subcritical water microreaction system. *Carbohydrate Research*, 371, 16–21 (2013). <https://doi.org/10.1016/j.carres.2013.01.024>
- 2) Taishi Hashiguchi et. al., Demonstration of the hepatocyte growth factor signaling pathway in the in vitro neuritogenic activity of chondroitin sulfate from ray fish cartilage. *Biochimica et Biophysica Acta- General Subjects*, 1810, 406-413 (2011). <https://doi.org/10.1016/j.bbagen.2011.01.001>.
- 3) Hiroko Mizuta et. al., Quantification of orally administered chondroitin sulfate oligosaccharides in human plasma and urine, *Glycobiology*, 2023, cwad054, <https://doi.org/10.1093/glycob/cwad054>
- 4) Shota Kawahara, et al., Mass Production of Purified Chondroitin Sulfate Oligosaccharides with Single Molecular Weight, *Bulletin of Applied Glycoscience*, 11(2), 94–99,2021
- 5) Mie Nishimura et. al., Daily Oral Chondroitin Sulfate Oligosaccharides for Knee Joint Pain in Healthy Subjects: A Randomized, Blinded, Placebo-Controlled Study, *The Open Nutrition Journal*, 12, 10-20 (2018).
- 6) Nobuyuki Miyamoto et. al., Effects of Continuous Intake of Nutritional Supplement Containing Chondroitin Sulfate Oligosaccharides for 12 weeks on Blood Pressure Reduction and Blood Vessels in Healthy Adults with High Blood Pressure — A Randomized, Double – blind, Placebo – controlled, Parallel – group Study —, *Japanese Pharmacology & Therapeutics*, 53 (11) 959-7 (2025)

## 6, Other

We publish research and technical information on chondroitin sulfate oligosaccharides online. Please feel free to use it. <https://nano10-9.jp/>

Please send your questions to [finechemical@mbf-net.com](mailto:finechemical@mbf-net.com).